REMARKS

This is intended as a full and complete response to the Office Action dated July 20, 2005, having a shortened statutory period for response set to expire on October 20, 2005. Please reconsider the claims pending in the application for reasons discussed below.

In the specification, the paragraphs 21-23, 28-30, and 32-36 have been amended to correct informalities. In amended Figure 1, previously omitted reference number 404 and 112 have been added. In amended Figure 4, reference number 404 has been renumbered to 406. In amended Figure 5, previously omitted reference number 404 and 112 have been added, the lead line for reference number 501 has been corrected, and one of the duplicated reference number 106 has been corrected to 110. It is submitted that the amendments are supported by the specification and drawings without adding new matter.

Claims 1-28 remain pending in the application and are shown above. Claims 1-28 stand rejected by the Examiner. Claims 1-3, 7, 9-10, 12, 18-19, and 23-25 are amended to correct matters of form and clarify the invention without introducing new matter. The amendments are supported by the Specification and Drawings at least at paragraphs 34 and 39. Reconsideration of the rejected claims is requested for reasons presented below.

Drawings

The drawings stand objected by the Examiner because element 112 is missing in the Figures. Applicants have amended Figures 1 and 5 to correct informalities and indicate the location of the membrane 112 as supported by the Specification at least in paragraphs 22-23 without introducing new matter. Withdrawal of this objection is respectfully requested.

Claim Objections

Claims 3, 7, 9, and 24 stand objected to due to informalities. Applicants have amended claims 3, 7, 9, and 24 to correct informalities and include proper Markush group expression. Withdrawal of this objection is respectfully requested.

Claim Rejections – 35 USC § 103

Claims 1-3, 9-10, 13-16, 25-26 and 28 stand rejected under 35 USC § 103 as being obvious over *Reid et al.* (US Patent Publication No. 2001/0015321) in view of *Dordi et al.* (US Patent Publication No. 2001/0052465) or *Woodruff et al.* (US Patent Publication No. 2001/0032788). The Examiner states that *Reid et al.* teaches a method of plating copper onto a substrate in a solution without using an ionic membrane, *Dordi et al.* teaches an ionic membrane, and *Woodruff et al.* teaches a NAFION perfluorinated membrane. The Examiner further states that an anolyte chamber and a catholyte chamber are inherently created when a membrane is used and it would have been obvious to combine the teachings because the ionic membrane of *Dordi et al.* or *Woodruff et al.* would filter out anode sludge from the electrolyte solution and eliminate the consumption of additives at the anodes. Applicant respectfully traverses the rejection.

Reid et al. discloses optimizing DC cathodic current densities to deposit a copper film on a substrate surface. *Reid et al.* does not describe a catholyte chamber and an anolyte chamber. In addition, *Reid et al.* does not describe a catholyte solution comprising one or more additives and an anolyte solution, and the difference between the catholyte solution and the anolyte solution is that the catholyte solution comprises the one or more additives.

Dordi et al. discloses a porous rigid diffuser positioned between a substrate and an encapsulated anode. The anode of *Dordi et al.* is encapsulated by a hydrophilic porous membrane having porosity between about 60% and 80% with pore sizes between about 0.025 micron and about 1 micron. The hydrophilic porous membrane of *Dordi et al.* allows an electrolyte solution having ions and additives therein to flow through, while filtering anode sludge and particulates from passing through by their sizes. (*See*, paragraphs 108 and 140.) *Dordi et al.* does not describe a catholyte chamber and an anolyte chamber. Further, *Dordi et al.* does not describe a catholyte solution comprising one or more additives and an anolyte solution, and the difference between the catholyte solution and the anolyte solution is that the catholyte solution comprises the one or more additives.

Woodruff et al. discloses an electrochemical processing chamber 200 and an interface member 700, which is a filter or ion-membrane designed to be positioned vertically in order to allow a secondary fluid flow F_2 to pass and join a primary fluid flow F_p, and prevent bubbles from the secondary fluid flow F_2 to pass, forcing bubbles in the secondary fluid flow F_2 to rise. (*See*, paragraphs 81, 83, 86-89.) When the interface member 700 is an ion-membrane, it prevents particles, organic additives, and bubbles in the secondary fluid flow F_2 to pass through into the primary fluid flow F_p and eliminates the consumption of the additives at the anode and the need to replenish the additives at the anode because the additives supplied to the secondary fluid flow F_2, which can be an anolyte, do not affect the primary fluid flow F_p. (*See*, paragraphs 88-89.) Thus, the anolyte of *Woodruff et al.* in the secondary fluid flow F_2 includes additives and can not be passed through into the primary fluid flow F_p. *Woodruff et al.* does not describe the difference between a catholyte solution and an anolyte solution is that the catholyte solution comprises one or more additives

Therefore, *Reid et al.* in view of *Dordi et al.* or *Woodruff et al.*, alone or in combination, do not teach, show, or suggest positioning the substrate in a catholyte solution contained in a catholyte chamber of a plating cell and applying a plating bias between the substrate and an anode positioned in an anolyte chamber of the plating cell, the anolyte chamber being separated from the catholyte chamber by an ionic membrane and being supplied with an anolyte solution, wherein the catholyte solution comprises one or more additives and the difference between the catholyte solution and the anolyte solution is that the catholyte solution comprises the one or more additives, as recited in claims 1, 10, 25, and claims dependent thereon. Withdrawal of the rejection is respectfully requested.

Claims 4 and 11 stand rejected under 35 USC § 103 as being obvious over *Reid et al.* in view of *Dordi et al.* or *Woodruff et al.*, and in further view of *Dahms et al.* (US Patent No. 6,099,711). The examiner states that *Dahms et al.* teaches an electroplating method for copper having an accelerator comprising bis-(w-sulfopropyl)-disulfide disodium salt and it would have been obvious to modify the combine method of *Reid et al.* in view of *Dordi et al.* or *Woodruff et al.* by using the accelerator of *Dahms et al.* as a suitable additive. Applicant respectfully traverses the rejection.

Reid et al., *Dordi et al.*, and *Woodruff et al.* have been discussed above.

Dahms et al. discloses an electrolytic method for plating copper on printed circuit boards by applying current pulse or voltage pulse and adding additives such as oxygen-containing, high molecular weight compounds and sulfur compounds with appropriate functional groups. *Dahms et al.* does not describe a catholyte chamber having a catholyte solution comprises one or more additives therein and an anolyte chamber having an anolyte solution and the difference between the catholyte solution and the anolyte solution is that the catholyte solution comprises the one or more additives, lacking in *Reid et al.* in view of *Dordi et al.* or *Woodruff et al.*

Claims 4 and 11 depend on claim 1 and 10, and *Reid et al.* in view of *Dordi et al.* or *Woodruff et al.*, and in further view of *Dahms et al.*, alone or in combination, do not teach, show, or suggest positioning the substrate in a catholyte solution contained in a catholyte chamber of a plating cell and applying a plating bias between the substrate and an anode positioned in an anolyte chamber of the plating cell, the anolyte chamber being separated from the catholyte chamber by an ionic membrane and being supplied with an anolyte solution, wherein the catholyte solution comprises one or more additives and the difference between the catholyte solution and the anolyte solution is that the catholyte solution comprises the one or more additives, as recited in claims 1, 10, and claims dependent thereon. Withdrawal of the rejection is respectfully requested.

Claims 5-8, 12, 17-18, and 27 stand rejected under 35 USC § 103 as being obvious over *Reid et al.* in view of *Dordi et al.* or *Woodruff et al.*, and in further view of *Horkans et al.* (US Patent Publication No. 2003/0000850). The Examiner states that *Horkans et al.* teaches an anolyte having a pH of between about 2 and about 4.8 and it would have been obvious to modify the combined method of *Reid et al.* in view of *Dordi et al.* or *Woodruff et al.* because an electroplating bath having an acidic pH of up to about 5 is used and known. Applicant respectfully traverses the rejection.

Reid et al., *Dordi et al.*, and *Woodruff et al.* have been discussed above.

Horkans et al. discloses an method for plating copper by controlling the concentrations of organic additives in a plating bath and determining the concentration of the organic additives by a cyclic voltammetry stripping (CVS) technique. *Horkans et al.* does not describe a catholyte chamber having a catholyte solution comprises one or

more additives therein and an anolyte chamber having an anolyte solution and the difference between the catholyte solution and the anolyte solution is that the catholyte solution comprises the one or more additives, lacking in *Reid et al.* in view of *Dordi et al.* or *Woodruff et al.*

Claims 5-8, 12, 17-18, and 27 depend on claim 1, 10 and 25, and *Reid et al.* in view of *Dordi et al.* or *Woodruff et al.*, and in further view of *Hokans et al.*, alone or in combination, do not teach, show, or suggest positioning the substrate in a catholyte solution contained in a catholyte chamber of a plating cell and applying a plating bias between the substrate and an anode positioned in an anolyte chamber of the plating cell, the anolyte chamber being separated from the catholyte chamber by an ionic membrane and being supplied with an anolyte solution, wherein the catholyte solution comprises one or more additives and the difference between the catholyte solution and the anolyte solution is that the catholyte solution comprises the one or more additives, as recited in claims 1, 10, 25, and claims dependent thereon. Withdrawal of the rejection is respectfully requested.

Claims 19-24 stand rejected under 35 USC § 103 as being obvious over *Reid et al.* in view of *Dordi et al.* or *Woodruff et al.*, and in further view of *Horkans et al.* The Examiner states that it would have been obvious to modify the electroplating method of *Reid et al.* by using the ionic membrane of either *Dordi et al.* or *Woodruff et al.* and the pH of *Horkans et al.* because the ionic membrane would filter out anode sludge from the electrolyte solution and eliminate the consumption of additives at the anodes and an electroplating bath having an acidic pH of up to about 5 is used and known. Applicant respectfully traverses the rejection.

Reid et al., *Dordi et al.*, and *Woodruff et al.*, and *Horkans et al.* have been discussed above.

Reid et al. in view of *Dordi et al.* or *Woodruff et al.*, and in further view of *Horkans et al.*, alone or in combination, do not teach, show, or suggest positioning the substrate in a plating cell having a catholyte solution volume, an anolyte solution volume, and an ionic membrane separating catholyte solution volume from the anolyte solution volume, contacting the substrate with a catholyte solution, applying an electrical bias between the substrate and an anode positioned in the anolyte volume, the electrical bias being

sufficient to plate copper ions from the catholyte solution onto the substrate, and replenishing copper ions plated from the catholyte solution via transfer of copper ions from an anolyte solution through the ionic membrane to the catholyte solution, the anolyte solution having a pH of between about 2 and about 4.8 and a copper ion concentration of between about 0.1M and about 2M, wherein the catholyte solution comprises one or more additives and the difference between the catholyte solution and the anolyte solution is that the catholyte solution comprises the one or more additives, as recited in claim 19, and claims dependent thereon. Withdrawal of the rejection is respectfully requested.

Claims 1 and 25-26 stand rejected under 35 USC § 103 as being obvious over *Landau et al.* '522 (US Patent No. 6,379,522) in view of *Dordi et al.* or *Woodruff et al.* The examiner states that *Landau et al.* '522 teaches a method for plating copper onto a substrate using an electroplating solution without an ionic membrane and inherently teaches positioning a substrate in a solution and applying a plating bias for an electroplating process. The Examiner further states that it would have been obvious to modify the electroplating method of *Landau et al.* '522 by using the ionic membrane of *Dordi et al.* or *Woodruff et al.* to filter out anode sludge from the electrolyte solution and eliminate the consumption of additives at the anodes. Applicant respectfully traverses the rejection.

Applicant respectfully traverses the rejection.

Landau et al. '522 discloses a plating method using blends of specific additives that enhance defect-free fill of small features, such as polyalkylene glycols as carriers and organic divalent sulfur compounds as accelerators. *Landau et al.* '522 does not describe a catholyte chamber having a catholyte solution comprises one or more additives therein and an anolyte chamber having an anolyte solution, and the difference between the catholyte solution and the anolyte solution is that the catholyte solution comprises the one or more additives.

Dordi et al. and *Woodruff et al.* have been discussed above.

Therefore, *Landau et al.* '522 in view of *Dordi et al.* or *Woodruff et al.*, alone or in combination, do not teach, show, or suggest positioning the substrate in a catholyte solution contained in a catholyte chamber of a plating cell and applying a plating bias

between the substrate and an anode positioned in an anolyte chamber of the plating cell, the anolyte chamber being separated from the catholyte chamber by an ionic membrane and being supplied with an anolyte solution, wherein the catholyte solution comprises one or more additives and the difference between the catholyte solution and the anolyte solution is that the catholyte solution comprises the one or more additives, as recited in claims 1, 25, and claims dependent thereon. Withdrawal of the rejection is respectfully requested.

Claims 10 and 13-14 stand rejected under 35 USC § 103 as being obvious over *Landau et al.* '433 (US Patent No. 6,113,711) in view of *Dordi et al.* or *Woodruff et al.* The examiner states that *Landau et al.* '433 teaches a method for plating copper onto a substrate in a plating cell, wherein the plating cell includes a porous membrane and does not explicitly teach that the porous membrane is an ionic membrane. The Examiner further states that it would have been obvious to modify the electroplating method and apparatus of *Landau et al.* '433 by using the ionic membrane of *Dordi et al.* or *Woodruff et al.* to filter out anode sludge from the electrolyte solution and eliminate the consumption of additives at the anodes. Applicant respectfully traverses the rejection.

Dordi et al. and *Woodruff et al.* have been discussed above.

Landau et al. '433 discloses a plating cell including a flow-through consumable anode 90 encased in a porous enclosure 94, an agitation device, and an auxiliary electrode to provide particulate-free electrolyte and uniform deposition on a substrate. (*See*, Abstract and Summary.) The porous enclosure 94 may be a ceramic or a polymeric membrane within which metal particles 92 can be encased and metal ions dissolved from the metal particles 92 of the consumable anode 90 can be filtered through (*see*, column 12, lines 34-45, lines 50-59.), such that the electrolyte of *Landau et al.* '433 can flow through the flow-through consumable anode 90. *Landau et al.* '433 does not described a catholyte volume having a catholyte solution comprises one or more additives therein and an anolyte volume having an anolyte solution, and the difference between the catholyte solution and the anolyte solution is that the catholyte solution comprises the one or more additives, which are lacking in *Dordi et al.* and *Woodruff et al.*

Therefore, *Landau et al.* '433 in view of *Dordi et al.* or *Woodruff et al.*, alone or in combination, do not teach, show, or suggest positioning the substrate in a plating cell, wherein the plating cell comprises a catholyte volume containing a catholyte solution, an anolyte volume containing an anolyte solutionan ionic membrane positioned to separate the anolyte volume from the catholyte volume, and an anode positioned in the anolyte volume, applying a plating bias between the anode and the substrate, plating copper ions onto the substrate from the catholyte solution, and replenishing the copper ions plated onto the substrate from the catholyte solution with copper ions transported from the anolyte solution via the ionic membrane, wherein the catholyte solution comprises one or more additives, the anolyte solution has a copper concentration of greater than about 51 g/L, and the difference between the catholyte solution and the anolyte solution is that the catholyte solution comprises the one or more additives, as recited in claims 10 and claims dependent thereon. Withdrawal of the rejection is respectfully requested.

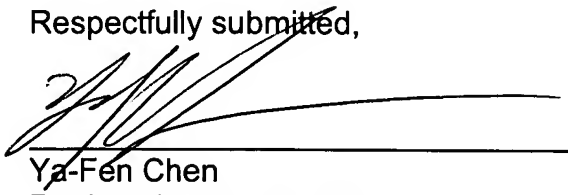
In addition, Applicant presents new claims 29-31 to be considered by the Examiner. New claims 29-31 are supported by the Specification and Drawings at least at paragraphs 20-24, 31-32, 35, and Figures 1 and 5 without introducing new matter. Applicant respectfully submits that *Reid et al.*, *Landau et al.* '522, or *Landau et al.* '433 in view of *Dordi et al.* or *Woodruff et al.*, and in further view of *Dahms et al.* or *Horkans et al.*, alone or in combination, do not teach, show, or suggest the subject matter as claimed in claims 29-31. For example, *Reid et al.*, *Landau et al.* '522, or *Landau et al.* '433 in view of *Dordi et al.* or *Woodruff et al.*, and in further view of *Dahms et al.* or *Horkans et al.*, alone or in combination, do not describe any ionic membrane positioned at a vertical position above the anode and in substantially parallel relationship to an upper surface of the anode.

In conclusion, the references cited by the Examiner, alone or in combination, do not teach, show, or suggest the invention as claimed.

The secondary references made of record are noted. However, it is believed that the secondary references are no more pertinent to the Applicant's disclosure than the primary references cited in the office action. Therefore, Applicant believes that a detailed discussion of the secondary references is not necessary for a full and complete response to this office action.

Having addressed all issues set out in the office action, Applicant respectfully submits that the claims are in condition for allowance and respectfully request that the claims be allowed.

Respectfully submitted,



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IN THE DRAWINGS:

The attached sheets of drawings include changes to Figures 1, 4 and 5. These sheets, which include Figures 1, 4 and 5, replace the original sheets including Figures 1, 4 and 5.

In Figure 1, previously omitted reference number 404 and 112 have been added.

In Figure 4, reference number 404 has been renumbered to 406.

In Figure 5, previously omitted reference number 404 and 112 have been added, the lead line for reference number 501 has been corrected, and one of the duplicated reference number 106 has been changed to 110.

Attachment: **Replacement Sheets (3)**
Annotated Sheets (3) Showing Changes

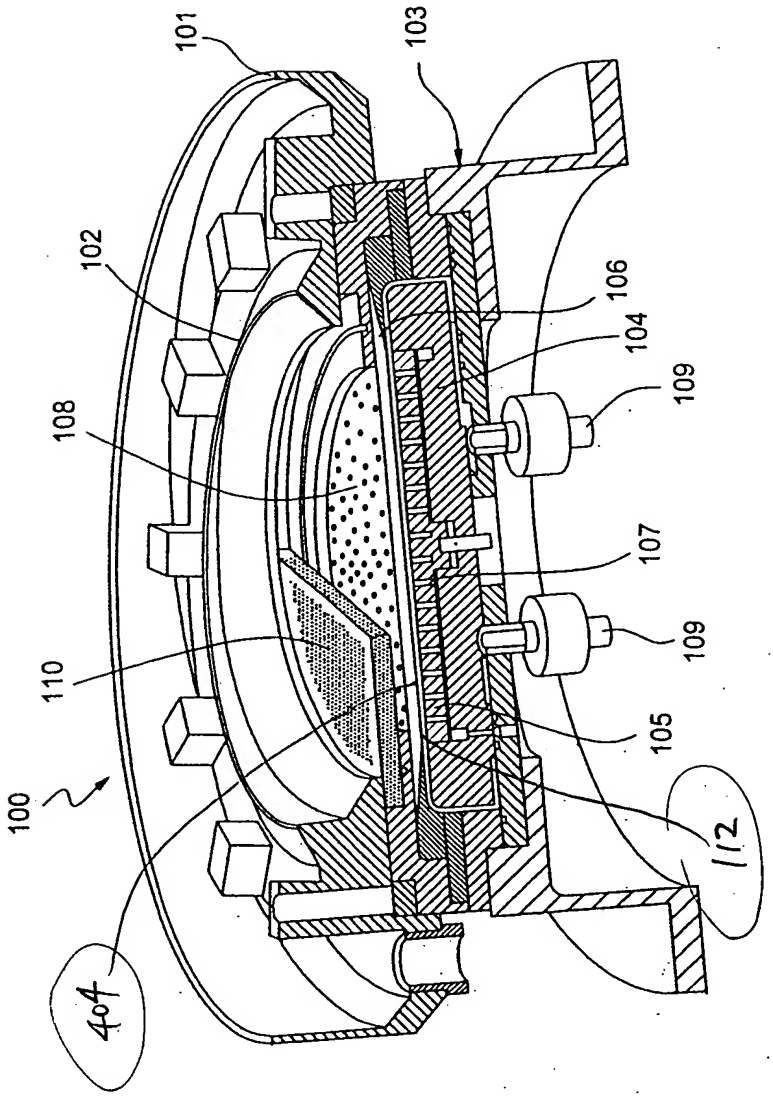

FIG. 1

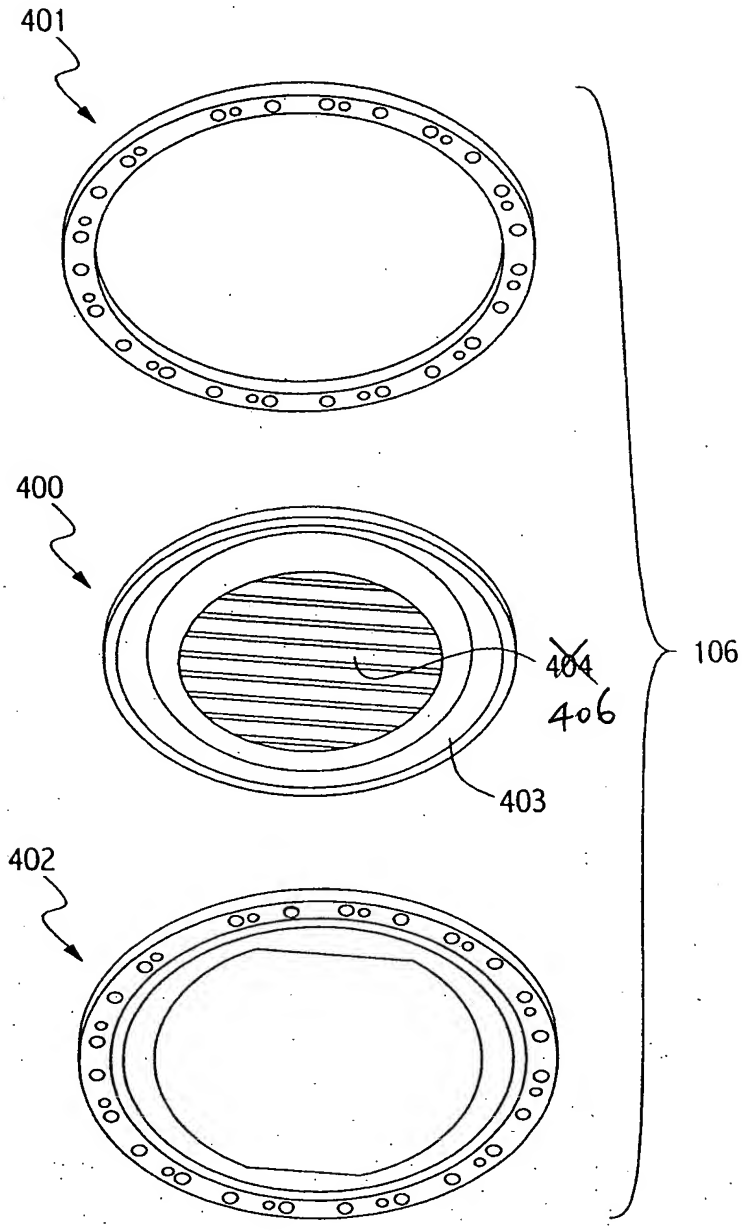

FIG. 4

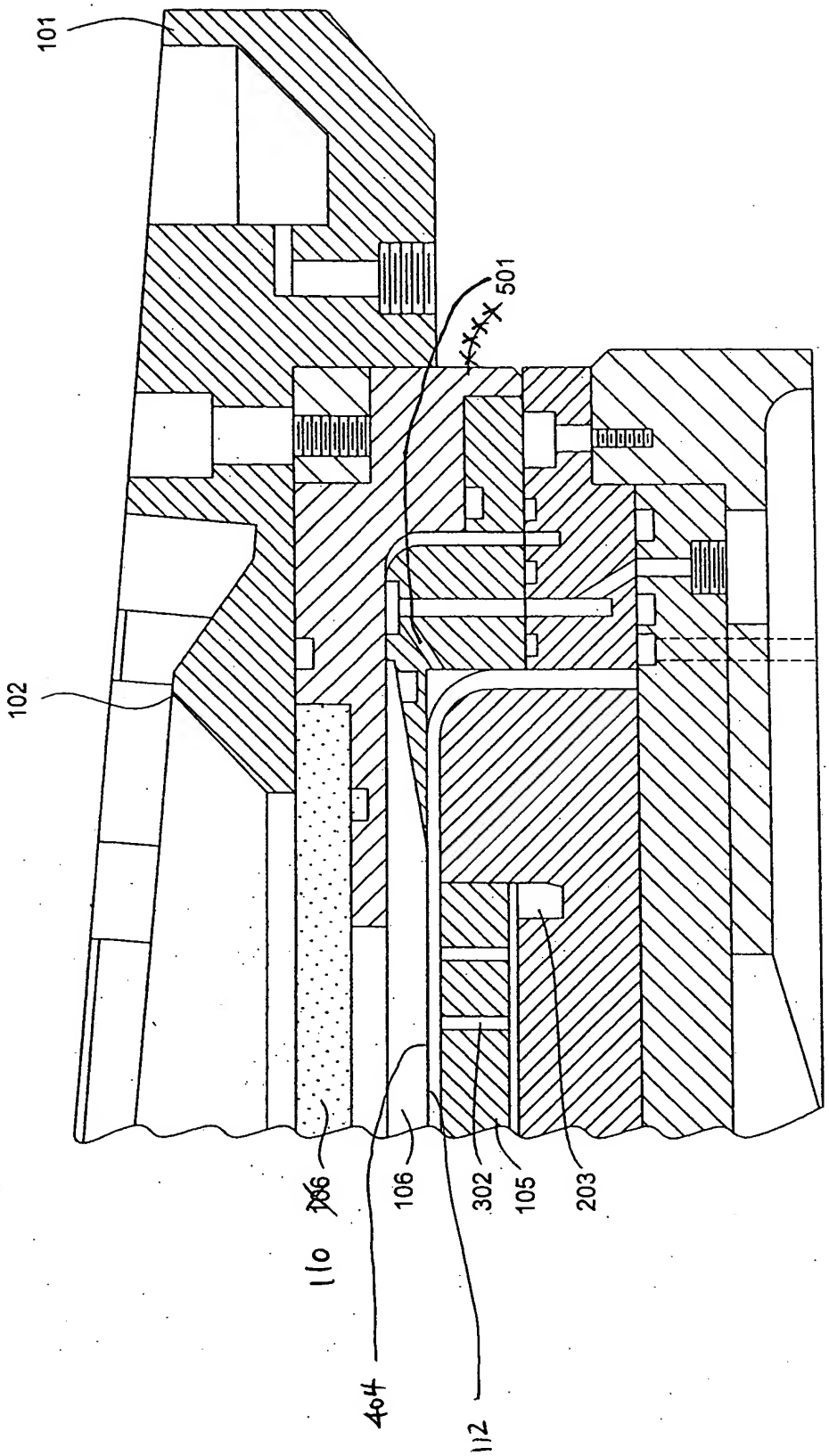

FIG. 5